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Address of President Wm. C. Butterworth, to the Wisconsin Gas Association.

At this our fifteenth annual meeting, it is fitting that we note how well our Association was founded, and some of the progress that has been made.

I know of no better tribute to the careful thought and strong building by our charter members than is expressed in Article II. of our Constitution, which reads:

2. "The objects of this Association shall be the promotion and advancement of knowledge, scientific and practical, in all matters relating to the construction and management of gas works, and the manufacture, distribution and consumption of gas.

3. "The establishment and maintenance of a spirit of fraternity between the members of the Association by social intercourse, and by friendly exchange of information and ideas on the before-mentioned subject matters.

4. "The inducement and extension of more cordial and friendly relations between the manufacturers of gas and their patrons, based upon mutuality of interests."

During these years, Wisconsin has been almost a pioneer in legislation for the regulating of Public Utilities; and we have gone through a period of grave concern for the integrity of our investments, and have "come through" safe and sound, and with a kindly attitude of public opinion toward the Gas Industry. This attitude will continue so long as we continue good faith in all our actions and avoid anything that is, or appears to be, contrary to the public welfare.

I have no fear of the regulations of public utilities by law so long as we have men of such ability and integrity as we have, and have had, in Wisconsin to execute the laws; and as long as we continue to honor the principals of our Association's Constitution. I congratulate the gas industry on the progress and increased business that is ours, but we must recognize that there is an inactive demand for gas service that we must meet before it becomes disgruntled from our neglect, and demands legislation forcing the service to be rendered.

The manufacturers of gas apparatus and appliances have produced wares that are thoroughly efficient and economical. The University of Wisconsin and the Wisconsin Mining School have contributed much to education and the development of our industry. It is our duty as members of the Wisconsin Gas Association to spread the information, and put these wares into profitable use in the inactive-demand for service, and do it now.

Mr. Sheldon J. Glass, our representative to the American Gas Institute, has obtained a very favorable affiliation agreement with the Institute, through which the members of this Association can have many of the benefits of the Institute at a nominal cost; all of which will be given in full in the report by Mr. Glass. I take pleasure in recommending the adoption of the report, and urge the members to join me in becoming an affiliated member of the Institute at this meeting.

The subject of a Public Relations Committee has been informally considered at times in the past. I believe the time has arrived when we should act. Therefore, I recommend for your consideration:

1. That a permanent Public Relation Committee be designated for this Association.

2. That the committee consist of our representative to the American Gas Institute, and two other members of the Association, one of whom shall be selected each year for a term of two years. (Two to be selected this year, one for a term of one year.) The President of the Association should be an ex-officio member of the committee, and a secretary should be selected by the committee.

3. The principal duties of this committee should be to note all matters in any way affecting the relations between the public and the gas industry; to assemble and classify information concerning the same; to determine the best practice to be followed to promote harmony and the welfare of the gas industry, and to consider questions of public relations with other Associations.

4. It should be the duty of the members of the Association to consult with and be advised by the Public Relations Committee on matters affecting public relations before action is taken; that we may promote more uniform practice, harmony and good will between the public and the Gas Industry.

I have received a courteous communication from Mr. James W. Dunbar, Secretary-Treasurer of the Indiana Gas Association, informing us that the Indiana Association has appointed a Standing Committee on rates; with a view of having a like committee appointed by us to co-operate with those already appointed by other Associations.

Mr. Dunbar informs us that the Pennsylvania, Illinois and Iowa Associations have appointed such committees, and if you install a Public Relation Committee, as recommended, this matter would automatically go to them. If not, Mr. Dunbar's communication should receive your further consideration.

This is our second joint meeting with the Wisconsin Electrical Association, and on behalf of the Wisconsin Gas Association, I extend to the members of the Wisconsin Electrical Association a hearty welcome, and urge them to participate in our discussions. Besides the growing cordial relations between the two Associations, there are some problems common to both that have contributed to the holding of these joint meetings. But, having considered the joint meetings, and in view of the wise building of our Constitution heretofore referred to, the increasing capital being invested in gas utilities, the increased educational facilities for the gas engineer in our universities and colleges, and the number of highly educated and successful men specializing on the gas problems, and in view of the increased consumption of gas throughout the United States and the "inactive demand" that is ours as we progress, I am of the opinion that the proposition of the joint meeting is unsound; and I feel that I would be untrue to the trust you have placed in me if I did not recommend, as I now do, that these few days during which the members of the Wisconsin Gas Association are together, be devoted to the purposes declared in our Constitution, keeping up with the best thought and highest ideals of the gas industry, and it problems.

The Physician in Industry.

By M. W. Alexander.

In the early history of medical work in industry, the regular employment of a physician in an industrial establishment was usually considered an evidence of a largely benevolent attitude on the part of the employer; but the results showed that the work of the physician in industry proved beneficial to the employer as well as to the employee, by protecting both against undue expense arising out of injury and sickness, and by promoting a better mutual relationship. The results also proved that medical supervision of employees increased their efficiency, and that prompt medical and surgical treatment of injured and sick employees prolonged their lives and the period of their industrial usefulness. As these advantages became known, medical supervision of employees was introduced in many plants, particularly where large numbers of men were employed.

The great value of the physician in industry became even more generally realized when workmen's compensation laws went into effect, which compelled the employer to shoulder the expense of injuries to employees regardless of the fault of either party. These laws forced the employer to provide adequate medical and surgical treatment for employees injured in his establishment, and also to exert all reasonable effort for the prevention of future accidental injuries, and for the elimination of conditions that might prove harmful to the health of his employees. Experience, however, had shown that physique, temperament and general physical condition of employees affected to a large extent their liability to sickness or injury. Some men could safely do work constantly requiring considerable physical effort, while the same work would cause discomfort and strain to other apparently strong men. Employees with defective vision would suffer headache while doing work that required close application of eyesight, while those with normal vision would naturally have no such trouble. Contact with certain odors or liquids used in manufacturing processes would cause skin irritation or other disturbances to one person, while hundreds of others working under the same conditions would be entirely unaffected.

These experiences naturally led the employer toward a study of the physical condition of his employees, in order to direct each of them into that employment for which he seemed best suited by virtue of his physical fitness, as well as by experience and skill; and vice versa, to divert him from employment that might be injurious to his health and safety. In order to pursue this course intelligently, physical examination of prospective employees and periodical re-examination of all employees became necessary. It is obvious that only a competent physician should be assigned to this task.

Aside from looking after the health of individual employees, the physician in industry also renders a valuable service by bringing to light general conditions of employment that may adversely affect the health and comfort. Many of these conditions would otherwise remain unremedied, because their ill effects are of such gradual development that the lay executive or employee might not detect their presence, or locate their source. By this co-operation with the employer and foremen in securing wholesome ventilation and proper lighting conditions, and by inducing employees, by personal advice or through suitable literature, to adopt healthful habits in the shop and home, the physician brings into play simple, far-reaching measures that tend to raise health and therefore the efficiency of the entire working force.

The Training of First-aid Men.

The physician also finds specific functions to perform, such as the training of a number of persons in each employment so that they can treat slight wounds, or give temporary assistance in cases of injuries that need attention pending a physician's arrival. The presence of such a body of trained first aid men is more important when the establishment is at a considerable distance from the physician's office or dispensary, or when injuries occur when a physician is not immediately available.

With these many advantages in mind, it is obvious that the physician has come into industry to stay. In a large plant he becomes part of the organization, and devotes his entire time to the welfare of its employees, while in smaller plants, or in those where the work is practicarly free from hazard, he spends only a part of the day in the medical care of employees, or combines a number of plants under his supervision. Apart from the medical aspect, however, enlightened employees are beginning to see the value of a physician as a staff member. They have learned to appreciate that his peculiar relationship to employees as a friendly medical adviser, enables him to exert a wholesome influence upon their mental attitude as well as upon their physical welfare. It should, therefore, not be surprising to find in the future physicians regularly attached to the organization of even small plants, where the medical supervision of employees alone would not be a task large enough to warrant the full time employment of a medical expert, but where his spare time may be used effectively in assisting the management in the general supervision of employees.

Special Tasks and Problems.

The physician in industrial practice encounters a great many problems that do not arise in private practice. He often finds himself dealing with people whose needs must be met promptly, effectively and with a minimum expenditure of time. Many of them are unfamiliar with the English language and unable to make their needs and wishes understood, or to understand the inquiries and directions of the physician who speaks English only; others are mentally backward; some are unclean and careless in their personal habits, thereby causing their wounds or ailments to improve very slowly even under the best care, while others have a generally antagonistic attitude. Some are even dishonest and try to conceal or falsify the real cause of an injury; they would rather feign inability and secure part pay while loafing, than perform honest work for full wages. Moreover, there are those who themselves believe, or by some doctors are led to believe, that they are seriously injured and incapacitated for work when they are not. The physician in industry must cope with all these conditions.

When the physician in industry should terminate his care, and at what point an employe's private physician should assume such responsibility, is another problem. What duties to delegate or not to delegate to the nurse employed in the establishment under his supervision; what instructions to give and what materials to furnish to laymen authorized to render first aid or emergency treatment; how to render some industrial operations free from the hazard of occupational disease, or how to protect workmen against such hazards if they cannot be eliminated, are questions that he is called on to answer.

In the solution of these problems the physician in industry often finds himself in a quandry. Previous training and experience have given no guide; in fact, many of these problems are but recently recognized. In many cases the physician is obliged to find an answer to each problem practically alone, and as best he can. Sometimes he hits on a method only partially satisfactory; sometimes achieves results that are all that could be desired, while at other times he failed in his aim. Occasionally, through a comparison of conditions and an interchange of experiences, physicians connected with industrial enterprises reach common conclusions that point to simple and practical remedies. The value of such informal conferences naturally lead to a desire for a more systematic interchange of ideas from a larger group of physicians dealing with medical problems in industry.

The Conference Board of Physicians.

A preliminary meeting of physicians engaged in industrial practice held in New York City, April 4, 1914, indicated that their experience could be combined and harmonized to give definite conclusions that would be valuable to themselves and to the industries they represented. It was also felt that the findings could advantageously be made available to all physicians in industry to the end that employers and employees generally might reap the benefit. The concrete outcome of this meeting was the organization of a "*Conference Board of Physicians in Industrial Practice*," the scope and work of which is embodied in the official declaration that--

"The Conference Board of Physicians in Industrial Practice is organized for co-operative effort in introducing into industrial establishments the most effective measures for the treatment of injuries or ailments of employees; for promoting sanitary conditions in workshops; and for prevention of industrial diseases."

In launching this movement, the Conference Board on Safety and Sanitation composed of the National Founders' Association, the

National Association of Manufacturers, the National Metal Trades Association, and the National Electric Association, has been a helpful factor, and the two Conference Boards have been working in close, harmonious relationship as business executives looking for professional advice in safeguarding the health of employees, and physicians offering medical judgment as the result of combined study and experience.

It was thought desirable to bring together at first only a relatively small number of medical officers of corporations, so as to facilitate the work and give discussions a more intimate character. In order to insure regular attendance at the meetings, only corporations in the eastern section of the country were asked to join the Conference Board, but industrial representation was diversified as far as practicable. The physicians now constituting the Board are all men of wide experience in their repective fields, and are familiar with the personal habits and the living and working conditions of people engaged in industry.

Dr. John J. Moorhead, of New York City, the Chief Medical Officer of the Interborough Rapid Transit Company and the New York Railways Company, is Chairman of the Conference Board, and M. W. Alexander of the General Electric Company, West Lynn, Mass., is Executive Secretary. The present members of the Board are: Dr. T. John Bowes, Philadelphia Electric Co., Philadelphia, Pa.; Dr. C. C. Burlingame, Cheney Brothers, South Manchester, Conn.; Dr. W. Irving Clark, Norton Company, Worcester, Mass.; Dr. Royal S. Copeland, Consolidated Gas Co., New York City; Dr. G. M. Dorrance, Joseph Campbell Co., Camden, N. J.; Dr. E. H. Hanna, Cadillac Motor Car Co., Detroit, Mich.; Dr. G. L. Howe, Eastman Kodak Co., Rochester, N. Y.; Dr. W. G. Hudson, E. I. duPont DeNemours Powder Co., Wilmington, Del.; Dr. J. A. Jackson, New York Edison Co., New York City; Dr. Chas. A. Lauffer, Westinghouse Electric and Manufacturing Co., East Pittsburgh, Pa.; Dr. Frederick W. Loughran, Medical Advisor, State Insurance Fund, New York City; Dr. D. B. Lowe, B. F. Goodrich Co., Akron, O.; Dr. John W. Luther, The New Jersey Zinc Co., New York City; Dr. A. C. Marshall, Powers-Weightman-Rosengarten Co., Philadelphia, Pa.; Dr. J. D. McGowan, Commonwealth Edison Co., Chicago, Ill.; Dr. Francis D. Patterson, Harrison Bros, & Co., Inc.; The J. G. Brill Co., Electric Storage Battery Co., Philadelphia, Pa.; Dr. W. E. Ramsay, The American Smelting and Refining Co., Raritan Copper Works, and Barbor Asphalt Paving Co., Perth Amboy, N. J.; Dr. L. M. Ryan, Hudson and Manhattan R. R. Co., The and Foundation Co. of N. Y., New York City; Dr. F. E. Schubmehl, General Electric Co., West Lynn, Mass.; Dr. John Woodman, New York Edison Co., New York City; Dr. Randall Zimmerman, Westinghouse Air Brake Co., Wilmerding, Pa.

The companies represented by these physicians employ over 250,000 men and women, skilled and unskilled, of many languages and nationalties, and working both inside and out in greatly diversified occupations.

The board meets periodically. So far 8 meetings have been held and some important results have already been achieved; much other work of far-reaching character is now under consideration. The individual members of the board are actively co-operating in research work on special problems that can be best studied in the particular industry with which they are connected. The results of individual investigations, however, are referred to the board for consideration and joint action.

Lead and Tar Paints on the Minidoka Reclamation Project.

The painting of the penstocks and draft tubes of the Minidoka turbine installation has been a source of considerable trouble, and several trials were made before anything was found to withstand the action of the water.

The shop paint was of red lead, or iron oxide, and oil, and a coat of red lead and oil was applied on the job, after assembling and riveting the pipes. After two years' service, examination showed that the paint had practically disappeared. After considerable study and experiment, with unsatisfactory results, the following formula for red-lead paint, obtained from one of the largest paint manufacturers in the country, was adopted, the lampblack being used as a hardener for the surface:

First Coat—30 lb. red lead per gallon of linseed oil, using one-third boiled and two-thirds raw oil.

Second Coat—Same as above, with 4 oz. of lampblack per gallon.

Third coat—Same as above, w . 4 lb. of lampblack to the gallon.

Paint was applied according to this formula during the winter 1912 13. After part of this work was done it was suggested to try the material used on the Los Angeles Aqueduct, and water gas tar was applied for the first coat and coal gas tar for the second and third coats. These were applied to penstock and draft tube No. 1.

At the end of the 1913 season the red lead paints applied as above showed decided deterioration where in contact with water, while the tar coating was in very good shape, except for slight rust spots around some of the rivets, where cleaning had evidently not been properly done. At the end of the 1914 season the red lead paint had almost entirely disappeared where exposed to water, and the tar paint was in good condition on the penstocks, but apparently getting rather thin on the outside of the draft tube. Where the red lead does not come in contact with the water, as on the upper part of the exterior of the draft tubes, it showed no deterioration and is still in excellent condition.

During the fall of 1914 the parts exposed to water on all the draft tubes were scraped, cleaned and repainted with water gas and coal gas tar. There was a considerable variation in the condition on the different tubes, due to the fact that some had two coats of lead and some three, and also because in some cases the weather was cold when the paint was applied, and it therefore may not have set sufficiently before being submerged. The tar paint on draft tube No. 1 could have gone much longer without renewing, but it was thought advisable to go over it in order to determine what condition the tar coating was in, and also to ascertain the condition of the iron underneath.

The cleaning was done with steel scrapers and brushes. With the lead paint, the iron was pitted badly, and it was necessary to thoroughly clean out the loose scale before repainting the metal. The rivet heads particularly presented a serious difficulty with the scrapers, and they found it very slow doing a good job cleaning around them. After finishing this work on the draft tubes, a special wire brush was made, which could be fitted over the rivet heads and revolved in a breast-drill frame. This worked satisfactorily, and materially reduced the cost of cleaning the penstocks.

The men working on this scraping were affected by lead poisoning, and precautions had to be taken to make their work intermittent. Even at that it was necessary for some of them to lay off for a considerable time to overcome the effects of the lead dust. After thoroughly scraping the iron, it was brushed down with scratch brushes, to remove the loose scale, but no attempt was made to get off all the dust prior to applying the water gas tar.

Excellent adherence was found between the metal and the tar paint that had been on $1\frac{1}{2}$ years at that time. Where scraped down to the metal it left a bright surface. On one patch, of about 1 square yard, apparently the iron had not been well cleaned before applying the paint, as it was in a place difficult to reach, and here scale had formed on the iron; but this was the only place the iron had not been protected from the water. Altogether, the results with tar have been most satisfactory.

There was quite a variation in the consistency of the water gas tar purchased at different times. As ordinarily obtained, it was necessary in the cool weather to mix a little gasoline with it. Usually the mixture was about 1 quart of gasoline to from 3 to 5 gallons of tar. This tar was then spread on carefully with a brush the same as ordinary oil paint, working it carefully into all pits and around rivets. One gallon of tar covered about 30 square yards one coat. The cost was about 15 cents per gallon, about one-half being freight charges.

The tar is rather slow in setting even if the weather is warm. It hardens when the thermometer drops, but when the weather warms up will become sticky even after a considerable period. As most of the work was done in cool weather, it was possible to apply the second coat within 10 to 14 days. In only one case (No. 4 draft tube) were they able to get a third coat on before the weather turned so bad that it was impossible to do outside work. It does not appear to affect the tar to put it into the water before it is thoroughly hardened.

The Reclamation Service is now testing this tar coating on a number of structures, both earth covered and exposed to the weather, under different conditions as to extremes of temperature, alkali action, etc.

The High Pressure System; and Welding Mains at Springfield, Mass.

[From paper by A. S. HALL, to the New England Association of Gas Engineers.]

In February, 1915, our high pressure system consisted of 12.8 miles of threaded and coupled pipe, ranging from ¾" to 4", and 14.6 miles of 4" universal pipe; 40 pounds per square inch being maintained throughout. Some of these mains were direct high pressure, with a governor on each service, while others supplied districts with low pressure through district governors. The plant at the Springfield works consisted of one Ingersoll-Rand, cross compound, duplex compressor, class H, size 11 18 10 inches and 16¼ 10 inches, and one straight line compressor 12 18¼ 12 inches.

In March, 1915, we had our first experience with welded high pressure mains. It being necessary to renew about 2,100 foot of 4" pipe, we used National Tube Company's 6", double random length, plain end, steel pipe, with welded joints. Although this trial did not prove a great success, either in making tight joints or low cost, we were satisfied that these difficulties could be overcome with a little further practice.

At this time we had just received a franchise to supply the town of South Hadley and Mount Holyoke College with gas. To do this we cut a 4" main into a existing 3" main, about 10 miles from the Springfield works, and from this point ran about 4 miles of 4" to South Hadley Center, and 2 miles on connecting streets. We used 4" double random length pipe on this job, all joints welded, and valves at intervals of 1,000 feet. At the end of the main line at South Hadley Center we installed 2 steel storage tanks, each 50' by 10' diameter, to maintain normal pressure during time of peak load. Fig. 1 shows the method of connecting the tanks.

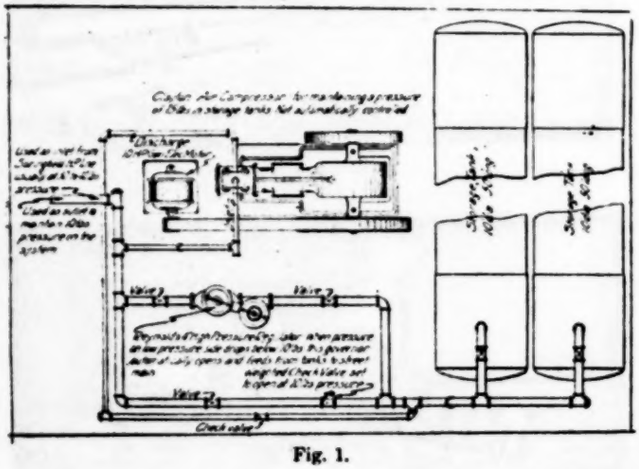


Fig. 1.

On the branch to Mt. Holyoke College we installed a Reynolds 4" single district governor, by-passed by a 2" house governor. Although the college uses from 17,000 to 25,000 cubic feet of gas daily, this 2" house governor has adequately cared for the supply.

The welders on this job were green men recruited from the ranks of our regular street gangs. As soon as one man became proficient another was broken in, until we had 6 capable welders, but being inexperienced, they were slow at first in making joints and wasteful of gas and filler metal. Some of the first joints, too, leaked and had to be re-welded. Welders received $2.50 per day, their helpers $2.25, and the other laborers $2. A total of 918 joints were welded on this job.

Cost of laying South Hadley 4-inch High-pressure Main.

Pipe (31,976 feet at $.2125)	$6,794.90
Labor, digging and backfilling	4,316.76
Labor, welding pipe	551.72
Labor, handling pipe	1,482.03
Engineering	370.79
Trucking	195.58
Oxygen (10,529 cubic feet)	210.76
Acetylene (11,667 cubic feet)	204.17
Filler metal (400 pounds)	$48.00
Valves (52 at $7.00)	364.00
Fittings	308.51
Sundries—Gasolene	19.92
Kerosene	4.08
Red lead	11.14
White lead	3.04
Carfare and telephone calls	7.00
Total cost	$14,892.40

Cost per foot.		*Cost per joint.*	
Pipe	$.2125	Labor	$.6010
Labor, digging and backfilling	.1350	Oxygen	.2296
Labor, welding joints	.0173	Acetylene	.2224
Handling pipe	.0463	Filler metal	.0522
Engineering	.0116	Total	$1.1052
Trucking	.0061		
Welding material	.0145		
Fittings, valves and sundries	.0224		
Total	$.4657		

Cost of Compressor Station.

2 steel storage tanks on foundations	$2,800.00
Concrete foundations	360.00
1 Clayton compressor	234.00
1 G. E. 10-horse power motor	225.00
Piping and fittings	119.39
(Labor, machine foundations, connections, wiring and fixtures)	339.91
Total	$4,078.30

We had but to glance at the above figures to be convinced that welding this double length pipe was the most economical method of laying high pressure mains.

Almost immediately we started to run a 6" high pressure main from the west bank of the Connecticut River directly opposite our works, through the towns of West Springfield and Akawam, 32,710' and across the river 2,100', to a point in the town of Longmeadow. From these we ran southerly through the towns of Longmeadow and Thompsonville, 18,533', and connected with the Northern Connecticut Light and Power Company's high pressure system. We already had an 8" steel main, with Dresser river couplings under the river from our works to the West Springfield shore, and it was from this that our new 6" main started.

Just outside the compression plant at the works we installed two pulsation tanks on the 8" river line, 6' in diameter and 18' in height. These tanks not only eliminate pulsation but also act as condensers, removing the bulk of the drip liquor from the line. Fig. 2 shows their connections.

This 8" main was laid in 1912 for low pressure, and when we decided to use it for high pressure we gave it an air test under 90 pounds per square inch and found a few leaks near the east shore. Examination showed this section deeply pitted from the effects of electrolysis. We renewed the pitted section with single length, extra heavy steel pipe, welded joints, and in order to eliminate electrolysis, installed two porcelain insulating joints on each side of the river. Terminals were welded to the pipe between each pair of insulating joints and run to manholes, so frequent tests could be made. The new 6" river main was equipped with similar insulating joints.

This river crossing between Agawam and Longmeadow, was laid under contract, of which more will be said later.

Before connecting to the Northern Connecticut Light and Power Company's system we ran our main through a meter house, in which we installed a 4" Rotary High-pressure Meter and a Foxboro Orifice Meter, leaving space for a Thomas Electric Meter and a Westcott Meter in addition. These meters are so connected that

any one or combination of meters can be run at a time. The meter house is heated by hot water using a Holyoke Tank Heater and the temperature controlled by a thermostat.

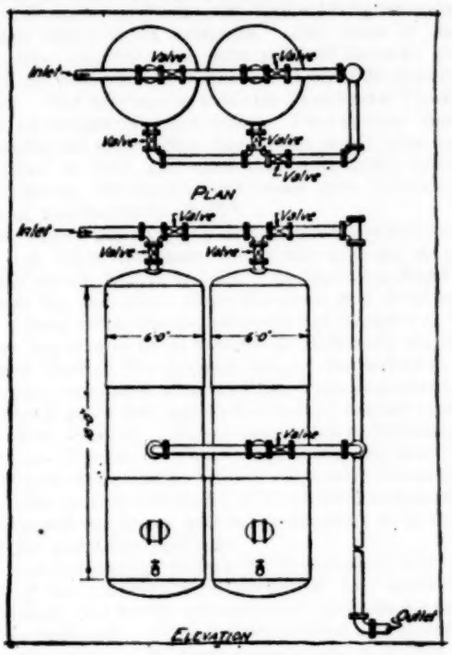


Fig. 2.

The following is the cost of this 6" main, not including the 2100 feet across the Connecticut river. A total of 1413 joints were welded on this job.

Cost of Laying Thompsonville 6-inch High-pressure Main.

Pipe (51,243 feet at $.3810)	$19,523.58
Labor, digging and backfilling	6,406.26
Labor, welding joints	1,005.49
Labor, handling pipe	2,544.18
Engineering	578.14
Trucking	1,226.45
Oxygen (22,559 cubic feet)	394.39
Acetylene (17,714 cubic feet)	310.00
Filler metal (1078 pounds)	129.36
Valves, 6", 4" and 2"	694.63
Fittings	512.90
Sundries	139.64
Total	$33,465.02

Cost per foot.

Pipe	$.3810
Labor, digging and backfilling	.1250
Labor, welding joints	.0196
Labor, handling pipe	.0496
Engineering	.0113
Trucking	.0239
Welding	.0162
Fittings, valves and sundries	.0264
Total	$.6530

Cost per joint.

Labor	$.7116
Oxygen	.2791
Acetylene	.2194
Filler metal	.0915
Total	$1.3016

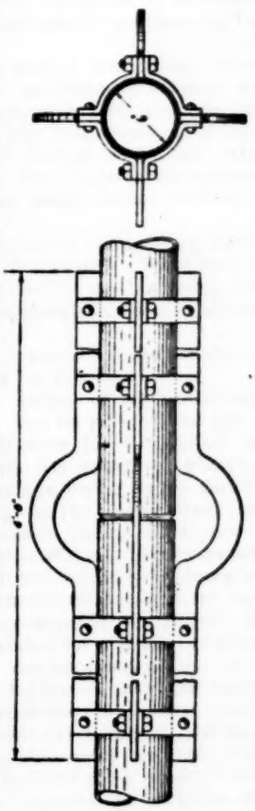


Fig. 3.

In granting permission to cross the Connecticut River, the War Department specified that the main be placed at least 3 feet below the river bed, which necessitated dredging a ditch. For $3,500 we contracted with the Springfield Navigation Company to do this work, including dredging, handling and laying the pipe, and refilling the ditch; our men doing the welding and testing.

A length of pipe was welded to the end of the main at the water's edge, the outer end resting on a barge. A second length of pipe was then hoisted into position and clamped to the first length, preventing the pipes from getting out of alignment by the motion of the boat. Fig 3 shows the clamp used. After the joint was welded and tested the barge was moved ahead, and the operation repeated. As each joint had to be tested separately before being lowered, the work progressed rather slowly, five joints being a good day's work. A drip pot made of a 7½' length of 10" pipe with two connections to the main was placed near each shore. Fig. 4 shows one of the pots welded into position. The 1" pipe protruding from the end of the pot was carried to a drip box on shore.

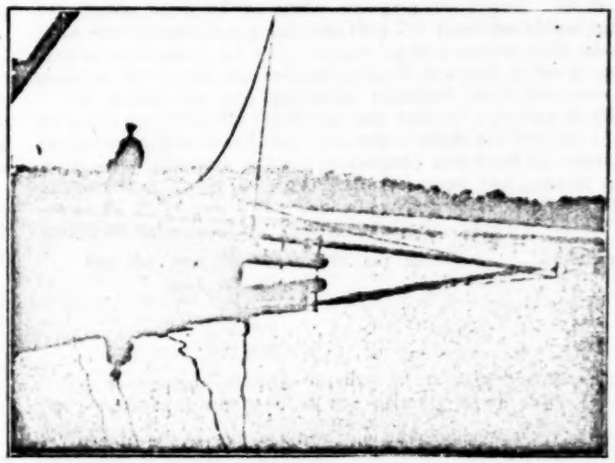


Fig. 4.

In ordering plain end pipe for a welded main, an important feature is the bevel to which the ends are cut. We found that the best angle for this bevel is 60° for the horizontal. It is necessary that the inner edges of the pipes be fused together before any filler metal is applied; and there must be enough metal in the thin edges to make this fusing possible. An angle much less than 60° does not give the necessary stock, and a hole is frequently burned through. On the other hand a bevel angle greater than 60° leaves the inner edges too thick to be easily fused, and does not have enough room in the groove for filler metal.

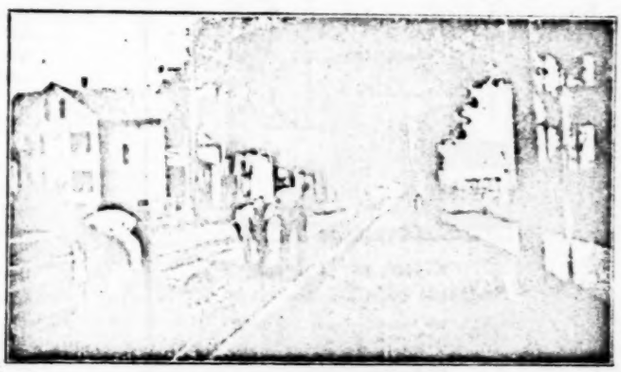


Fig. 5.

We found it more economical to weld together and test long sections of pipe before placing in the ditch. Fig. 5 shows a section of 6" pipe, 3,500 feet long, the welders being far ahead of the diggers. In order to keep ahead of 40 men digging and backfilling, we worked two welding gangs of three men each on the welding ahead, and another gang of two men connecting the long sections in the ditch and making fittings. An average day's work for welders was about 16 joints on 4" and 11 joints on 6" pipe. If a man can assume a comfortable position while welding, he is more likely to do good work. Notice the welder in Fig. 6, sitting on a small wooden bench, with an arm resting on either knee. No welder should be allowed to light a torch without having on a pair of goggles.

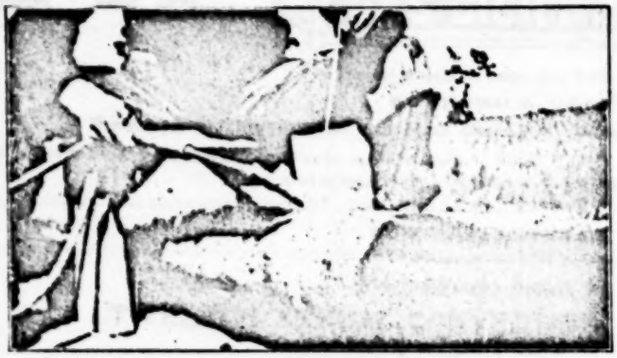


Fig. 6

For handling long sections of pipe we made skids by bolting old Robins Conveying Belt idlers to 2" planks (Fig. 7). At first we used chain falls to lower the sections into the ditch, but soon found that 4" and 6" pipe could be lowered much more quickly by the method shown in Fig. 8.

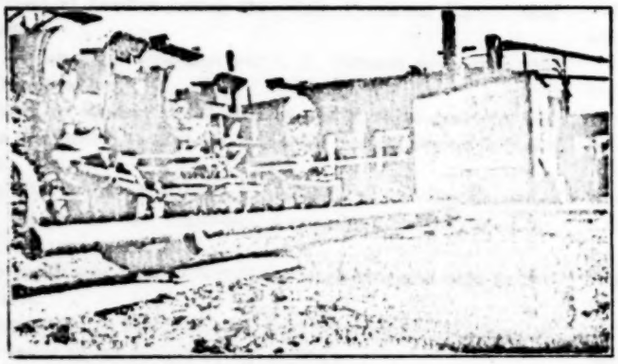


Fig. 7.

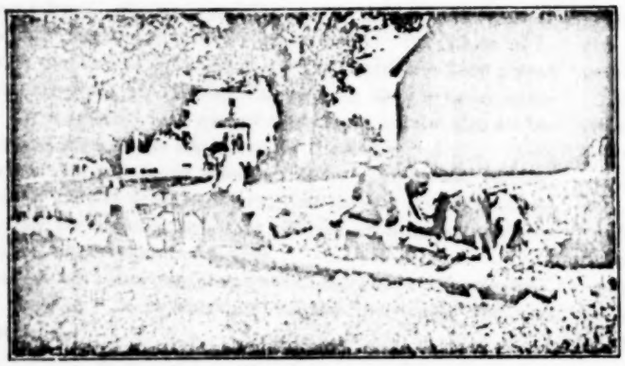


Fig. 8.

Before the sections were lowered into the ditch they were tested with air at 90 pounds pressure and soapsuds. The pressure was maintained on the pipe until the section was lowered into the ditch, when the joints were again tested. We used a 20 horse power Abenaque Portable Compressor to obtain our test pressure. Fig. 9 shows method of attaching the pressure connection to the end of the section to be tested.

As much care was taken in grading these mains as with low pressure mains, drip pots being placed at all low points. Fig. 10 shows a typical pot.

It has been stated by some authorities that expansion and contraction can be taken care of by simply "snaking" the pipe into the ditch. This may be good practice in some localities but we do not recommend it where the temperature changes are great. It is our practice to place an expansion joint each 1,000 feet. Although flanged valves are generally used in mains of this kind we used extra heavy semi-steel, screw end valves.

One of the great advantages of welded mains is the variety of

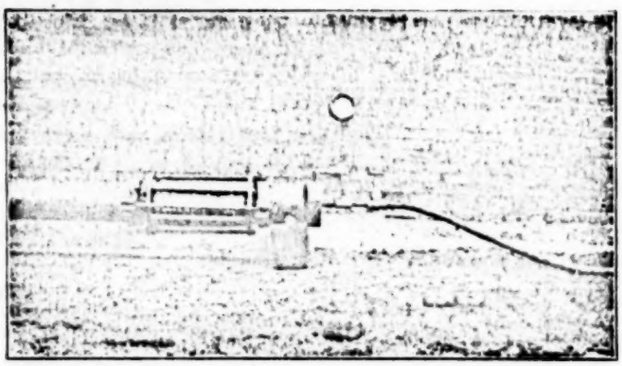


Fig. 9.

bends and fittings that can be made on the job. All of our drip-pots and tees, and most of our bends were welded this way. To facilitate this work sheet metal patterns were made to aid the welder in cutting the pipe. In some cases we made special long radius bends in the shop and then welded them into the line.

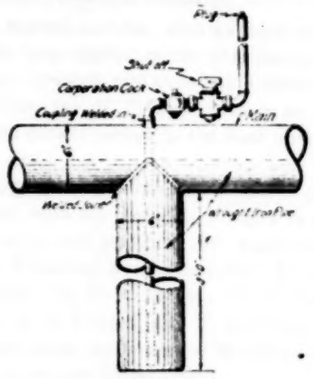


Fig. 10.

One more argument in favor of welded high pressure mains over threaded and coupled mains: In answer to a recent inquiry as to the relative cost of plain end pipe, and threaded and coupled pipe we received the following:

Size of pipe.	Cost per ft. of welded and coupled pipe.	Cost per ft. plain end pipe.
2"	$0.09	$0.085
4"	.27	.26
6"	.48	.46

Take the 6" pipe for example. By using plain end pipe a saving of $0.02 per foot, or $0.80 per double length is made before the pipe leaves the mill. This goes a long way in paying for a joint.

We can truly say we are thoroughly convinced that the laying of high pressure mains with welded joints, is the most economical We realize this method is still in its infancy, but feel sure that it will soon be in general use. In the light of our success, we are considering the advisability of running low pressure welded mains under certain conditions.

N. C. G. A. Offers $500 In Prizes to Its Members.

$100 for the best window displays used during Gas Range Week.
$100 for 4 best records for Industrial Fuel Sales.
$100 for 4 best records for Domestic Fuel and Lighting Sales.
$100 in monthly prizes for N. C. G. A. Bulletin contributions.
$ 25 for best paper on what the N. C. G. A. can do to benefit its individual members more directly.
$ 25 for best paper on how can the enthusiasm of gas salesmen be stimulated?
$ 25 for best plan for organization and class study of N. C. G. A. educational courses.
$ 25 for best paper on securing, training and promotion of gas company employees.

If you are not a member, send for application blank and booklet, "What the N. C. G. A. Can Do For You."

The Springfield Rate Decision.

The State Public Utilities Commission of Illinois has just handed down a decision in the largest rate making procedure before it in the two years of its existence. Gas rates in Springfield, Ills. (population 60,000) have been reduced from $1 per 1,000 cubic feet to 80 cents net—a reduction of $50,000 annually to gas consumers. The hearings in this case have lasted 2 years; over 4,000 pages of testimony were taken. Twenty-four separate hearings consuming 62 days' time have been held; final hearing was on November 6, 1915, and since that date briefs have been filed by the litigants; twenty-nine witnesses gave testimony or presented exhibits, numbering in all 217.

The present gas company in Springfield evolved from the Springfield Gas Light Company, which was granted a charter by the Legislature of Illinois in 1854. At that time $3.25 per 1,000 was charged for gas—four times the price now fixed by the Commission. Since 1854, the gas property has grown and changed hands. It now appears to be in control of Hodenpyl, Hardy & Company, of New York. The greater part of the existing plant seems to have been purchased with earnings from past years, growing from one 60,000 cubic foot gas holder to four holders totalling 1,345,000 cubic feet capacity. Street mains have increased from a few blocks, to 87 miles in length; and there are over 10,000 services between the street mains and the consumers premises, and there are over 9,000 meters installed. The company now manufactures both coal-gas and water-gas, and as by-products is producing tar, coke, ammonia and other residuals.

In the proceedings before the Commission, five separate valuations of the property were presented, two made by the City of Springfield, two by the gas company, and one by the Commission's engineering staff. All the experts followed different theories, and the values derived by them varied from $500,000 by the city, to $1,200,000 by the company. In general, the company's experts employed the so-called "reproduction method," whereas the city's experts employed either the "equivalent plant," or the "original investment" method. All the methods are described at length in the Commission's order.

The Commission, after thoroughly analyzing all evidence fixed $800,000 as a fair value of the Springfield Gas property for rate making purposes.

A much debated question was that of land value. The City's expert claimed $7,900 sufficient for the Company's lands; whereas the Company placed local real estate experts upon the stand to show the present value to be in the neighborhood of $55,000. The Commission made no direct finding as to land value, but included it in the total valuation. The Commission, however, excluded a portion of certain lots as being neither used nor useful for gas making purposes.

Another debated question was that of including or excluding a 1,000,000 cubic feet holder recently erected. The City's experts claimed that the capacity of the holder was excessive, but the Commission found the capacity not unduly large, and allowed proportional value for the holder.

Discussion arose regarding allowances for undisturbed paving, the Company making some claims for this item.

"Undisturbed paving, despite claims of certain advocates of 'reproduction-cost-new' theories, has no place in the case at bar. No legitimate reason can possibly exist for demanding that the public, after having improved its city streets at great expense, should pay a higher unit price for gas, owing to the fact that the pavement, which is the property of the public itself, and not owned by the gas utility, possesses value. This, and similar claims, often lead the reproduction theories to irreconcilable absurdities and render the same of less weight as evidence in valuation proceedings than would prevail either in more consistent theories or in more reasonable application of reproduction theory."

The Company made extensive claims for overhead expenses, that is items such as (1) engineering during construction, (2) contingencies and incidentals, (3) administration and legal expense, (4) supervision and tools during construction, (5) interest upon capital expended during construction, and (6) insurance and taxes; aggregating $178,000. The Commission made no direct finding on this, other than to state that it believed the Company's claims excessive. For working capital and materials and supplies, the Commission allowed $56,000—$30,000 for materials and supplies and $26,000 for working capital.

The Commission discusses "depreciation" at length, and in its order made deduction from "cost new" to cover accrued depreciation. Following a consistent policy, the Commission granted an annual allowance of $15,000 for a depreciation account as prescribed by the Illinois statute.

Some ten or twelve pages of the Commission's opinion are devoted to a discussion of "going value," the four commonly accepted interpretations being taken up in order and disposed of. As to this Company, the Commission finds "there is no proof in the record of the case at bar that the investment necessary to organizing and establishing the business has not been compensated for in rates charged and collected under previous ordinances."

After discussing rate of return, the finding "as to an equitable rate of return," taking into consideration the nature and inherent risks of the public utility investment in general, and particularly considering all the facts and circumstances relating to this particular gas utility, as well as the testimony regarding the local peculiarities and characteristics of Springfield and its population, is that 7% per annum is a fair rate of return upon the fair and reasonable value of the active gas property found. At the same time, the Commission points out that 7% upon the entire gas property is equivalent to 10% return upon a proper stock issue, and equal to 15% upon the moneys actually invested in the property.

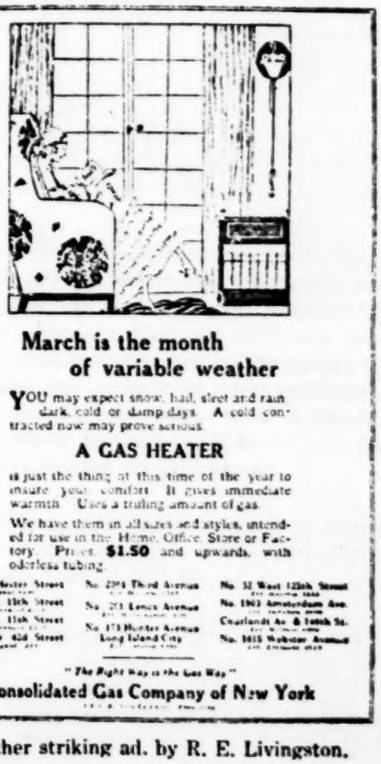
For production and operating expenses, the Commission found 50 cents per 1,000 for equitable rate making purposes in this particular case; disallowed the Company's claim for $30,000 to cover expenses of this rate making procedure; and fixed the standard of gas at 600 B. T. U. per cubic foot, removing the present restriction of 18 C. P. gas. The following rates were ordered, effective within 30 days from the date of the Order—April 9, 1916.

For the first	10,000	cu.	ft.	per	month	$0.80 net
" " next	10,000	"	"	"	"	.75 "
" " "	30,000	"	"	"	"	.70 "
" " "	150,000	"	"	"	"	.65 "
" all over	200,000	"	"	"	"	.60 "

The Company's present schedule of rates in Springfield, which has remained unchanged in the primary block since 1894, is as follows:

Minimum (collected quarterly)					Per Month	$0.25 net.
First	10,000	cubic feet	at	$1.20	gross	1.00 "
Next	10,000	"	at	1.10	"	.90 "
"	30,000	"	at	1.00	"	.80 "
"	30,000	"	at	.95	"	.75 "
"	30,000	"	at	.90	"	.70 "
"	50,000	"	at	.85	"	.65 "
Over	200,000	"	at	.80	"	.60 "

A Timely and Effective Advertisement.


March is the month of variable weather
YOU may expect snow, hail, sleet and rain dark, cold or damp days. A cold contracted now may prove serious.
A GAS HEATER
is just the thing at this time of the year to insure your comfort. It gives immediate warmth. Uses a trifling amount of gas.
We have them in all sizes and styles, intended for use in the Home, Office, Store or Factory. Prices $1.50 and upwards, with odorless tubing.
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Published Weekly by The American Gas Light Journal, Inc., at 42 Pine Street, New York City.

ELBERT P. CALLENDER, Pres. and Treas. FREDERICK A. SOUTHWORTH, Vice-Pres.

CHARLES H. WADELTON, Secretary and Manager.

NEW YORK, MONDAY, MARCH 27, 1916.

[Special Report by Telegraph.]

TWELFTH ANNUAL CONVENTION, ILLINOIS GAS ASSOCIATION.

CHICAGO, ILL., March 22.

The "top" of this morning was a blizzard, but about 150 had reached Chicago in time to be on hand when President Harper called the first session to order at 10 o'clock.

The first regular business was the report of the Board of Directors; and then the election of new members, bringing the total membership up to 400.

Vice-President Bradley taking the chair, President Harper read his address.

E. H. Negley, H. O. Channon and L. H. Johnson were appointed a committee thereon.

Messrs. R. A. Wallace, E. H. Negley and S. H. Moore were designated a Committee to prepare memorial resolutions on deceased members.

Colonel Pratt, the Association's delegate to the Gas Congress, who did not go to San Francisco, transmitted the report of Mr. Eustace who represented him.

The report of the Public Relations Committee was read by Secretary Clark.

The Committee on Gas Rates reported through Mr. Wallace, advocating lower prices for gas in competition.

The Affiliation Committee seemed somewhat mixed as to the revised plan of the Institute, and recommended that the subject be further considered. However, if the matter is not acted upon at this meeting it will mean a whole year's delay. On motion of L. H. Johnson, the Association pledged itself to contribute $200 a year toward the expenses of the Gas Engineering Course to be established by the Institute. All agreed that it was a good step to begin the preparation of gas engineers for the future.

The Committee on Meter Shelves, report read by Mr. Negley, urged greater care in setting meters; that they be properly placed and accessible for reading, and that shelves or other supports be insisted upon for prepayment meters.

The first formal paper was that on "Constructive Advertising" by J. W. Lansley. It covered the subject thoroughly and was well received.

This afternoon's session was opened at 2 o'clock, R. C. Downing reading his paper on "Utilization of Gas Oil." It was discussed by Messrs. Pratt, Hart and Spitzglass, the latter reading a carefully prepared comment.

Mr. J. B. Klumpp, Secretary of the Institute Committee on Public Relations, addressed the convention on the "Gas Safety Code," bespeaking the support of all gas men for this work of the Bureau of Standards, in order that the code may be properly framed.

Mr. Hanson's paper on "Disposal of Gas House Wastes," was interesting, but too much blame was put upon the gas works in some of the instances noted. For instance, the condition of the Passaic River was blamed on the works at Paterson, N. J., forgetting all the silk dyeing plants that discharge waste water into that stream.

The paper on "Gratituitous Work," by A. L. Tossell, told of Chicago practice, and of their charge maintenance work. They have no difficulty in getting such work on actual cost basis and believe it should be paid for. Prompt response, quick delivery of appliances, etc., and strictly keeping promises, give real service.

The last paper of the session was that by W. H. Forbes, "Efficient Use of Gas in the Home," after which we adjourned.

THURSDAY MORNING SESSION.

This morning's session opened on time, with a record attendance; and New Business was the first matter on the programme.

Some new members were elected, and then the Association acted favorably on a request from the N. C. G. A. that it go on record as favoring a change from candle power to the heat unit basis for determining the value of gas.

E. H. Taylor offered a resolution authorizing that a committee be appointed to co-operate with the Bureau of Mines in compiling a history of the gas industry, and pledging the Association's support in the work. The following were appointed: E. H. Taylor, F. E. Luther, Carroll Miller, E. D. V. Dickey, H. O. Channan, F. W. Bedard, E. W. Smith, R. S. Russell, and H. H. Clark.

The Committee on Resolutions on Deceased Members presented their report and formal resolution for adoption.

The report of the Committee on President's Address was read by E. D. V. Dickey. They concurred in the President's recommendations, and endorsed his keynote of constructive co-operation; and repeated that no gas man can fail to be impressed with the great possibilities of the gas business.

The Nominating Committee reported, and the following were elected: President, C. W. Bradley; Vice-President, F. W. Bedard; Secretary Treasurer, H. H. Clark.

Mr. E. D. V. Dickey was chosen a Director; and G. F. Goodnow, first president of the Association, was named as representative to the Institute. All the officers elect voiced their formal thanks for the honor done them.

Mr. Sauer's paper on "Stores Accounting," was then read; followed by "Industrial Welfare Work," by S. H. Moore, and "Solicitors and House Record Cards," by E. D. V. Dickey.

The afternoon session listened to the paper by Milt Saul, on "Functions of Trade Journals; and that by G. C. Carnahan on "Bunsen Gas Burner Design and Operation."

Mr. J. G. Learned read a short paper on the activities of the N. C. G. A., relating mainly to its bulletins, pamphlets and educational courses, and invited the co-operation of the Association and individual members. The convention thereupon adjourned.

More than 500 sat at the dinner and entertainment this evening. The principal speakers were Dr. F. W. Gunsaulus, who described the wonders of light and showed about a hundred pictures of flowers, fruits and objects of art in their natural colors; and W. E. McKay, President of the Institute, speaking in humerous vein.

The Choral Society of the Peoples Gas Light and Coke Company sang delightfully, and ministrels in character make-up were entertaining. Altogether, this Convention is about the best the Association has ever had, and the Committees derserve unstinted praise.

FIFTEENTH ANNUAL CONVENTION WISCONSIN GAS ASSOCIATION.

The Fifteenth Annual Convention of the Wisconsin Gas Association was called to order at the Hotel Pfister, Milwaukee, at 11:30 A. M., March 15th, by President Wm. C. Butterworth. Registered attendance 58 active and 34 associate members.

The President announced that the Executive Committee had appointed, as a nominating committee, H. W. Easterly, I. F. Wortendyke and C. F. Asendorf.

The reading of the minutes of the previous meeting was omitted.

The Executive Committee reported on new membership applications, recommending 21 persons for active members and 9 for associate members.

The Executive Committee submitted an additional report recommending the discontinuance of joint meetings with the Wisconsin Electrical Association, but the report failed of adoption. Secretary-Treasurer reported a generally satisfactory condition of the Association, and read a communication from ex-President J. H. Walker, who had been confined to his home by illness for about a month.

The communication was received with considerable evidence of feeling, and on motion a committee was appointed to visit Mr. Walker and express to him the sentiments of the meeting.

Communications were received acknowledging the receipt of invitations to the convention from :

Geo. G. Ramsdell, Secretary American Gas Institute; R. B. Harper, President Illinois Gas Association; Clark R. Graves, Secy. and Treas. Michigan Gas Association; James Dunbar, Secretary Indiana Gas Association, and T. V. Genay, Secy.-Treas. Iowa District Gas Association; and read into the records.

Through E. H. Donnelly, of Milwaukee, the family of Judge Jos. J. Donnelly transmitted its acknowledgement of the Association's expression of sympathy on the death of Judge Donnelly, who had become so well known to the members of the Association by his oratory at Association dinners.

S. J. Glass, the Association's affiliated representative to the American Gas Institute, reported the terms of the new affiliation agreement with the Institute; and, on motion, the Association voted to accept the agreement, and authorized its officers to execute the same. A number of members immediately signified their intention of availing themselves of the privleges thus offered.

President Butterworth hereupon read his annual address, which was referred to H. W. Johonett, Ewald Haase and H. D. Schall, as a committee.

The President then introduced Mr. J. Shapiro, of the engineering staff of the Railroad Commission of Wisconsin, who submitted tables on "Comparative Statistics of Wisconsin Gas Companies with reference to Development of Business, Saturation of Territory, and Miscellaneous Expenses and Revenues." Mr. Shapiro went into considerable detail in comparing the various properties, evidencing a thorough understanding of conditions existing in the various localities. Although apparently nothing but cold figures, the paper was enthusiastically received.

The next paper was that of Mr. O. L. Kowalke, Associate Professor Chemical Engineering University of Wisconsin, on "Some Characteristics of Pyrometers useful in the Gas Industry."

Next in order was "Coal Tar, it's Uses and Development," by Arno C. Wilke, Chemist, Milwaukee Gas Light Co., a very timely write-up upon coal tar residuals.

The session then adjourned until 10:00 o'clock Thursday morning.

Thursday Morning Session.

In order to enable Mr. Sanborn to keep another engagement, the first paper read was that on "A Review of Legislation during the Past Session of the Wisconsin Legislature;" although this paper was intended for the joint session of the Gas and Electrical Associations.

Next followed the paper entitled "Is a Gas Company Justified in Charging a Higher Rate for Gas Served Through a Prepayment Meter," by A. R. Manley.

Several "Wrinkles" were submitted; one by J. Peter Eastman, describing the use of a boiler force feed pump in connection with service stoppage. W. E. Haseltine submitted, under this head, a form of combination consumers' ledger card, that he found very practical.

The Nominating Committee submitted a report recommending as follows:

For President, F. L. Cross, Madison.
Vice-President, Guy F. Gregg, Milwaukee.
Secretary-Treasurer, Henry Harman, Milwaukee.
Affiliated Representative to American Gas Institute, S. J. Glass, Milwaukee.

On motion the report was adopted, and the Secretary instructed to cast the ballot of the convention for the nominees.

The Committee on President's address, which also had under consideration a communication from the Indiana Gas Association relative to the appointment of a Committee on Gas Rates, recommended the appointment of a permanent "Public Relations Committee."

In recognition of this report a resolution was offered and unanimously adopted, under which the incoming President is to appoint a special committee with the powers and duties outlined for the Public Relations Committee as described in the President's address.

The committee appointed to call upon Mr. Walker reported his condition much improved.

In view of the fact that a circular has been issued under the official heading of the Industrial Commission of Wisconsin, and lectures are being held in various places in the State, in which no recognition is given to gas as an agent for efficient factory lighting, the chair was authorized to appoint a special committee to investigate the subject, and if it sees fit to communicate with the authorities responsible for the article on shop lighting referred to. The chair appointed I. F. Wortendyke, H. W. Easterly and R. B. Brown. Hereupon followed adjournment.

Thursday Afternoon Session.

Under the joint auspices of the Gas and Electrical Associations, Mr. Harold L. Geisse, Secretary of the Railroad Commission of Wisconsin, read and discussed a paper on "The Attitude of the Railroad Commission of Wisconsin on Security Issues."

Mr. T. E. Lyons, a member of the Tax Commission of Wisconsin, then read a paper on "Method of Taxation of Public Service Companies in Wisconsin and why Taxes have been increasing Annually."

At the banquet, held in the Fern Room of the Hotel Pfister, in the evening, covers were laid for 286 persons, it being a brotherly function with the Wisconsin Gas Association, the Wisconsin Electrical Association and the Wisconsin Electrical Exhibitors Association. Mr. H. J. Desmond acted as toastmaster, and the speaker of the evening was Lou J. Beauchamp, a humorous writer and Chatauqua lecturer of note. Addresses were also made by L. A. Olwell and P. T. Bowler for the Electrical Association, and by Col. E. G. Pratt, and Rev. C. H. Beale, representing the gas interests.

Notes.—Chicago sent a fine delegation. Messrs. E. G. Cowdery, John Williamson, O. T. Knight, and C. A. Luther responding to special invitation from the "Wisconsin" Secretary.

We missed these of the distinguished "regulars:" John Dell, of St. Louis; E. S. Dickey, of Baltimore; O. O. Thwing, of Ft. Wayne; Geo. F. Goodnow, of Waukeegan; John J. Knight, of Kalamazoo; Harbison (who writes the postals to himself), and Colonel Geo. D. Roper; "Bud" (alias Allen P.) Knight was present and Bill Weadley, too.

Notes on Purification.

Paper by WILLIAM BENNETT, to the Scottish Junior Gas Association.

Briefly, the impurities in crude coal gas consist of aqueous and tarry vapors, carbon dioxide (CO_2), sulphuretted hydrogen (H_2S), ammonia (NH_3), carbon bisulphide (CS_2), with other sulphur compounds and cyanogen bodies. The quantity of each of these impurities present depends on a variety of facts—the coal itself, its physical condition, the moisture content, the duration of charges, temperature and method of carbonization. In vertical retorts the regulation of the heat is a factor governing the impurities produced—that is, the impurities are different when working good top heats than when there is a fairly long uniform heat.

It is essential that the tar and tar-fog be removed to the fullest extent; otherwise trouble will be caused in the purification plant, by "clogging up" the brushes and filling material in the scrubbers, and the oxide in the purifiers.

The thick tar should be removed quickly, before the condensers and while the gas is still at 140° to 160° F., to prevent undue absorption of the light hydrocarbons. The light tars and tar-fog must be removed before the gas enters the scrubbers, and care should be taken that all tar, after condensing, is removed at once from contact with the gas; otherwise, the tar will give back naphthalene vapors to the gas. This was very noticeable with us when working with horizontal retorts. The tar in the seal-pot of the tar-extractor and inlets to the well gave off considerable naphthalene, which deposited on the seal-pot cover and crown of the well, just as ammoniacal liquor flowing into the open gives off NH_3. With gas from the verticals the naphalene content is very low, and we do not find this effect.

The removal of carbon dioxide by lime purification is a process of the past. Since the addition of carbon dioxide only reduces the calorific value *pro rata*, then so long as we can keep the CO_2 content down to reasonable limits, we need not concern ourselves about its complete removal. What we should aim at is a gas of nearly uniform composition and calorific value.

If CS_2 and sulphur compounds other than H_2S can be removed simply and at little cost, no one will object to doing so. But unless in abnormal quanties, they are of little consequence.

There is without doubt some corrosive action in meters, service-pipes, and gas holder plates, due to cyanogen; and this action is increased by traces of ammonia and oxygen in the gas—ferrous ammonium ferrocyanide ($Fe(NH_4)_2Fe, (Cn)6$) and prussian blue ($Fe_2(Cn)18$) being formed. In "Notes on the Corrosion of Service Pipes," read by Mr. Macleod before the Institution of Gas Engineers in 1911, analyses were given of deposits from services in Greenock, all of which showed the presence of cyanogen. This internal corrosion is not only detrimental to the pipes and fittings, but forms a nucleus for the deposition of naphthalene, often resulting in stoppages. The cyanogen also locks up a certain amount of the purifying material by combination, and forms a protective coating round some of the oxide—preventing complete sulphiding. With vertical retorts the cyanogen content is low; but with horizontals and high temperatures, and consequently a greater amount of hydrocyanic acid, it may be advisable to remove it altogether preceding the purifiers.

The removal of impurities commences immediately the temperature of the gas takes the down grade; but apart from tar extraction, and partial naphthalene removal, the gas reaches the washers or scrubbers before we have much control over the operations. From $\frac{5}{10}$ths to $\frac{7}{10}$ths of the ammonia yield is condensed out with the aqueous vapor in the hydraulic mains and condensers; and this virgin liquor, having condensed out at comperatively high temperatures, contains but little H_2S and CO_2, and, instead of being allowed to flow into the common well, may be separated from the tar and afterwards used in the scrubbers, where it can be usefully employed to remove CO_2.

It is intended in these notes to deal but briefly with washing and scrubbing, and to go more fully into dry purification by oxide of iron. At the inlet of the scrubber the NH_3, CO_2 and H_2S may be taken to be present to the extent of, roughly, 130, 3,000, and 800 grains, respectively, per 100 cubic feet of gas. The removal of ammonia is effected by taking advantage of its solubility in water. At ordinary temperatures and pressures one volume of water will dissolve 760 volumes of NH_3, 3 volumes of H_2S and one volume of CO_2, when the absorbent water is brought into intimate contact with the pure gases at full atmospheric pressure. When dealing with mixed gases, such as crude coal gas, the pressure exerted by each constituent is the same as if it alone were present and occupied the whole space. That is to say, if the percentage of NH_3 present is 0.4, the pressure exerted by the NH_3 is the same as if 0.4 cubic foot of ammonia was expanded to 100 cubic feet, or $\frac{4}{1000}$th of the total pressure.

By Henry's law, the volume of a gas aborbed is directly proportional to the pressure exerted by the gas; so, if dealing with clean water, the NH_3 absorbed would only be $\frac{4}{1000}$th of the above figure. Further, given a fixed temperature, liquors of varying strength have certain ammonia pressures, varying directly with the strength. If this pressure is greater than the ammonia pressure in the gas, ammonia will be given up to the gas. If the ammonia pressure in the gas is greater than that in the liquor, ammonia will be absorbed. To put it another way, ammonia molecules are constantly leaving and entering the liquor, and equilibrium is established when the same number of molecules leave and enter the liquor in the same time. If the pressure of the gas is increased, more molecules of ammonia enter the liquor in a given time and a greater volume is absorbed, until the strength of the liquor is increased to give a pressure to balance the increased ammonia pressure in the gas. Consideration of this fact leads to the conclusion that it is wrong to place a washer on the exhaust side as is sometimes done. The pressure exerted by the last traces of ammonia is so small that it is extremely difficult to get it into solution.

The absorption of ammonia increases with a decrease in temperature of the washing water; but the temperature should not be too low, otherwise ethylene and benzene are thrown out. Other actions take place besides the absorption of ammonia in water; ammonia having an affinity for both the H_2S and CO_2, as represented by the following equations:

(1) $NH_4OH + H_2S = NH_4HS + H_2O$
(2) $2NH_4OH + H_2S = (NH_4)_2S + 2H_2O$
(3) $NH_4OH + H_2Co_3 = NH_4HCO + H_2O$
(4) $2NH_4OH + H_2CO_3 = (NH_4)_2CO_3 + 2H_2O$

It will be seen from these that, even if we could utilize all the ammonia in the gas and have the most favorable chemical actions—(1) and (3)—taking place, there is not anything like the amount of ammonia present for complete purification at this point. Self purification, or the extraction of the H_2S and CO_2 in the gas by the NH_3 present, is a fascinating problem for chemical engineers, and many processes have been brought forward with a view to utilizing the ammoniacal liquor over again after expelling the H_2S and CO_2, in order to make up for the initial shortage of ammonia required for the complete elimination of these impurities.

None of the processes brought forward, however, is so simple and sure as to warrant disuse of the efficient, if somewhat cumbersome, oxide purification. The acid radical CO_2 is a stronger acid than H_2S, and will turn out the latter from combination with ammonia. This being so, the plant should be so arranged that the liquor is kept in contact with the gas for a lengthened period, in order that the CO_2 shall largely be absorbed at the scrubbers and the H_2S driven forward to be dealt with by the purifiers. Another point to be noted is that where liquor is sold on a distillation test, no credit is given for the sulphur content, which, under present methods of oxide purification, means a direct loss of revenue. Further, where the cyanogen is not specially extracted, the lengthened liquor contact will—where air for revivification is admitted before the washers—reduce the cyanogen content of the gas by forming ammonium sulphocyanide. In this case there will be a slight loss of sulphur and the fixing of a little ammonia. Working in this way, the liquor can be made to take up about five equivalents of CO_2 to one of H_2S, and at the same time the strength of the liquor is brought up.

Dry Purification.

As already stated, the use of lime is being rapidly abandoned. The frequency of changes required, the cost of the lime, and the nuisance when spent, made it far from being an ideal material.

Unlike lime, oxide of iron is limited in its action to H_2S, and under certain conditions HCn and possibly CS_2, the CO_2 passing forward unchanged. The fouled material is readily revivified for use again.

Formerly, the usual procedure was to have three out of four boxes working, with one off for emptying and revivifying. When the gas showed foul on entering the third box, the sequence was altered, so that No. 2 became the first, and the clean box was placed last. The first box, now foul, was then shut off and emptied; the material spread in the open for revivification. The following represent the reactions taking place:

Sulphiding
$$2\ Fe_2O_3H_2O+6\ H_2S=2\ Fe_2S_3+8\ H_2O$$
$$2\ Fe_2O_3H_2O+6\ H_2S=4\ Fe\ S+2S+8\ H_2O$$

Revivification
$$2\ Fe_2S_3+3O_2+2\ H_2O=2\ Fe_2O_3H_2O+6\ S$$
$$4\ Fe\ S+3O_2+2\ H_2O=2\ Fe_2O_3H_2O+4\ S$$

The oxide was thus brought back to its original state with the deposition of free sulphur. The result is just the same as if the oxide merely acted as a catalytic agent for the oxidation of the H_2S, thus:

$$6\ H_2S+3O_2=6\ H_2O+6\ S$$

After revivification the oxide is returned to the box, which was placed last in the series, when another change was made. The number of changes required to bring the sulphur up to 50% varied from 12 to 14. The process was both expensive and offensive—gas being lost at each change, and heat evolved when revivifying, causing unpleasant odors.

The next step made was the introduction of oxygen (as air) with the gas, so that revivification would go on at the same time as sulphiding. This was a decided advance, and the number of changes required was reduced. Working as before, however—that is, the foulest box first and the clean box last—it was found impossible to get the theoretical quantity of oxygen taken up.

From the equations given above there appears to be no chemical reason why the actions should not go on indefinitely if the right amount of air be admitted and the conditions be such that the actions go on at equal rates. The only reason for any change is increase of bulk causing compacting and preventing intimate contact between gas and oxide by deposition of sulphur. Other factors, however, enter into the question; but these will be dealt with later. For the moment look at it from the point of view represented by the above equations. Why should the oxygen not be taken up to the full extent?

Quantitative tests have been made of the H_2S and O_2 in the gas at the inlets of each of the boxes. These tests show that the sulphiding action and oxidation of the sulphides formed do not take place, to any extent, side by side. Generally H_2S alone is taken up by the first box, the oxygen passing through into the other boxes, which, being comparatively clean, offer but little scope for oxidation.

The next step undertaken was an attempt to separate the processes of sulphiding and oxidation, so that the oxygen passing through the boxes actively sulphiding would enter the boxes already sulphided unaccompanied by H_2S. Under these conditions the oxygen is very active in the oxidation of the sulphides. This separation of H_2S and O_2 is brought about in two ways—either by "forward rotation" or "backward rotation." To work the system successfully, the valves and connections to the boxes should be so arranged that the purifiers may be worked in any order. All four boxes are in use at once which is a great saving over the old method of three boxes on and one off—that is, 25% of the plant out of use. In the "forward rotation" method, the gas would be passed through series 1, 2, 3, 4, until showing foul at the inlet of No. 3 box. The order would then be changed to 2, 3, 4, 1, bringing the foulest box last. Tests show that the H_2S is taken up by the first two boxes, while oxygen is taken up actively by the last two boxes. When the gas at the inlet to 4 shows sufficiently foul, or alternately when an excessive amount of oxygen is getting past the purifiers, the series is again changed to 3, 4, 1, 2. Nos. 3 and 4 now take up the H_2S while Nos. 1 and 2 are being revivified, and so on.

The following represents the series of changes:

1, 2, 3, 4; 2, 3, 4, 1; 3, 4, 1, 2; 4, 1, 2, 3; 1, 2, 3, 4.

When a box is first in the series, it takes up about 95% of the H_2S, and continues to do so for three or four weeks—depending, of course, on the rate of flow. It is difficult to remove the remaining 5% in the second box; and it often happens that sufficient gets to the third box to show foul. It is difficult to explain why this should be.

The following tests were made on the purifiers at Greenock. The purifiers, which were seen when the Association visited Greenock some weeks ago, consist of six boxes, 40′ by 30′ by 6′ deep, with dry lutes, operated by Weck valve—one for two boxes and one for four boxes. Hurdle grids are used.

Order of Boxes, 4, 5, 1, 2.

	H_2S at Inlet.	H_2S Taken Out by Box.		
	Grains per 100 Cubic Ft.	Grains per 100 Cubic Ft.	Per cent. of Total H_2S Entering Purifiers	Oxygen Taken Up per Cent. by Volume of Gas.
No. 4 box.....	554.5	527.1	95.06	...
" 5 "	27.4	20.6	3.72	...
" 1 "	6.8	6.8	1.22	0.3
" 2 "	0.0	0.0	0.00	0.1

It will be seen that although only 27.4 grains of H_2S per 100 cubic feet of gas enter No. 5, the second in the series, it only takes up 20.6 grains, leaving 6.8 to be dealt with by the third box. In order to demonstrate that No. 5 box was able to take up much more than this, the series was altered immediately after the above tests—5, 6, 1, 2 becoming the series. Tests made 24 hours later showed:

Order of boxes 5, 6, 1, 2.

	H_2S at Inlet	H_2S Taken out by Box.		
	Grains per 100 Cub. Ft	Grains per 100 Cub. Ft.	Per cent. of Total H_2S Entering Purifiers.	Oxygen Taken Up per Cent. by Volume of Gas
No. 5 box.....	575.7	517.2	89.84	....
" 6 "	58.5	49.0	8.51	0.05
" 1 "	9.5	9.5	1.65	0.30
" 2 "	0.0	0.0	0.00	0.10

It does not often happen that oxygen is taken up in the second box—No. 6 had been standing off for some time owing to having caked up, and was very foul, and this is probably why oxygen was taken up. It will thus be seen that when in first position No. 5 is capable of taking out 517 grains of H_2S, whereas in the second position it is unable to take out 27 grains. The gas flow was the same in both cases, and the temperature of the box 59° F. in the first position, and 61° F. in the second. One possible explanation of the above results is that the presence of HCn, as free acid, might retard the final purification; the tendency of the oxide to take up H_2S being partly neutralized by the tendency of HCn to liberate H_2S from FeS.

$$18\ FeS+36\ HCn=18\ Fe\ (Cn)_2+18\ H_2S.$$

In the presence of oxygen this $Fe\ (Cn)_2$ would be converted into prussian blue.

$$18\ Fe\ (Cn)_2+3O_2=2\ Fe_2O_3+2Fe_3\ [Fe\ (Cn)_6]_2.$$

If the above action proceeded at a slower rate than the action of H_2S on the oxide, the additional contact in a further box would complete the removal of the H_2S. This, however, can only be a partial solution of the problem, for it still leaves the question as to why the HCn in passing through the last box, which is in a very sulphided stage, does not liberate the H_2S, unless it be that the HCn is here reduced to such a dilution limit that it ceases to be active. It is held in some quarters that HCn does not act on FeS. If this be so, it may still, if present in large quantities, act as a poisoner, preventing the absorption of H_2S by the oxide. Apart from all this, the molecular concentration of the H_2S is very low, and the rate of chemical action will be correspondingly slow also, requiring a larger mass in order to deal with it.

The following table shows the distribution of the H_2S and O_2 by tests made some time ago:

Series 1, 2, 5, 6, 3.

	H_2S in Gas.		O_2 in Gas.
	Per Cent. by Volume.	Grains per 100 Cubic Feet.	Per Cent. by Volume.
Inlet of No. 1 box.....	0.820	507.0	0.40
" 2 "	0.084	52.0	0.35
" 5 "	0.022	13.6	0.35
" 6 "	0.022	13.6	0.10
" 3 "	0.006	3.7	...

H_2S and O_2 Taken out by the Purifiers in the Above Tests.

	H_2S.		O_2.
	Grains per 100 Cubic Feet of Gas.	Per Cent. of Total H_2S Entering Purifiers.	Per Cent of Gas by Volume.
No. 1 box.....	455.0	89.74	0.05
" 2 "	38.4	7.57	....
" 5 "	....	....	0.25
" 6 "	9.9	1.95	0.10
" 3 "	3.7	0.74	....

As a rule the extraction of H_2S is completed in the third box, and oxidation commences in this box also, possibly in the lower part. But these tests showed a rather curious state of affairs.

Slight oxidation took place in the first box, but sulphiding went on until down to 13.6 grains. The process then completely changed to oxidation, and would appear to have completed oxidizing before reverting back to sulphiding. The result was that H_2S was not eliminated before the fifth or catch-box. In changing the series, it is best to be guided by the oxygen absorption. When the quantity of oxygen taken up by the purifiers permanently decreases, it is time to change.

In the backward rotation system, the final box is, at each change, brought to the first place in the series. Taking four boxes as before, we should have the following series:

1, 2, 3, 4; 4, 1, 2, 3; 3, 4, 1, 2; 2, 3, 4, 1; 1, 2, 3, 4.

Thus a box originally the first in the series travels backwards towards the end of the series. We have not tried this method, the other having been quite successful. A box gets well sulphided in the first position, and one would not think it is then in the best condition for taking out the final portions of the H_2S as is required of a box in the second and third positions. In the forward system, a catch-box is required to catch the foul gas already in the box on changing to the last position. Where there are only four boxes and no catch-box, this can be obviated by making the changes more frequent, so that H_2S never shows at the outlet of the third box, and, following out the backward method, making rapid changes until the second series of the forward method is arrived at—*e. g.*:

1, 2, 3, 4; 4, 1, 2, 3 (rapid); 3, 4, 1, 2 (rapid); 2, 3, 4, 1.

When the oxide is well spent in a box and requires to be taken out, this is indicated by the box becoming quickly fouled when in the first position, with the result that only partial revivification in the last two boxes has been effected when a change of series is required.

There are causes other than the material being spent which might bring about this result. Before emptying a box, therefore, judgment should be used as to whether the material is spent; and it is a good plan to take samples of the oxide for analysis. This can easily be done by inserting a sampler through a plug on the covers. When it is found that the oxide is really pretty well spent, the box should be placed last in the series—that is, follow out the ordinary sequence—and gas passed through it in this position for a couple of days. This will precipitate the sulphur to some extext, so that on opening-out oxidation is reduced and the risk of fire minimized. If the system is intelligently worked, outside revivification and mechanical disintegrators for breaking up the partially spent oxide become unnecessary.

It has been stated that a purifier would not clean up in the last position, if operated as the first box for two or three weeks, and would only do so if operated as the first box for two or three days or so and then changed to the last. This is in contradiction to our whole system of working. The last box certainly does pick up any oxygen that enters, even though previously in the first position for five or six weeks.

There are many factors that influence the efficient working of oxide purifiers. First the oxide itself—*i. e.* its composition, physical state, size and wetness. It should contain a high percentage of hydrated ferric oxide, and be in small particles.

As a mixing material, old oxide in the proportion of one of old to five of new is good, and much better than shavings, sawdust, or coke breeze, the former two of which are difficult to mix, and all depreciate the value of of the spent material and increase the liability of fire speading, should one take place locally. When put in ready mixed, the oxide should contain just sufficient moisture to prevent it passing through the bottom grids. If too wet when put in, "rat holes" are formed on drying, through which the gas takes short cuts.

The chemical action in the purifiers is exothermic—heat being evolved. This heat should be conserved. If the oxide is too wet the heat is rendered latent by evaporation of the water, and the temperature, and consequently efficiency, of the oxide is reduced. Most oxides have their highest efficiency at about 80° F., but with some of us this temperature at the purifiers would result in the gas passing through the station meter at an abnormal temperature, and be very misleading unless frequent observations of meter temperatures were made. We try to work at 65° F. If the temperature falls much below 50° the oxide becomes sluggish.

In our case the boxes are heated by a coil of 2" steam-pipe passing round the bottom inside the boxes. We recently introduced live steam into the inlet leading to the last box—the gas here being free from H_2S—with a view to seeing the effect on the sulphur compounds. Our investigations are still proceeding, sufficient tests not having yet been made to justify any conclusions.

A large purifying area is also esantial, to give sufficient time-contact between the gas and oxide for chemical actions to be completed. The gas must be free from tar-fog before entering the purifiers; otherwise the oxide is made a filter, with subsequent back-pressure troubles before the oxide is spent.

In some quarters the caking of oxide is somehow or other associated with revivification *in situ*. Our experience is that it is the first box in the series that cakes-up; yet, as will be seen from the table of H_2S and O_2 absorption, little or no oxygen is taken up here. Prior to the introduction of vertical retorts, and also about the same time that toluol extraction by tar washing was being carried out, our tar extraction was very complete, and we had little or no trouble with caking oxide. The tar from verticals contains only from 1 to 2% of "free carbon," against about 20% in horizontals, and the removal of tar-fog becomes much more difficult.

The following analyses of samples of oxide from the top caking layer, half-way down, and from the bottom of a box that had been throwing 10" pressure, point to the conclusion that the light oils and tar-fog carried forward by the gas to the purifiers, together with moisture and heat of chemical action, play a big part in caking.

Analyses of Samples of Spent Oxide.—Dry Basis.

	Top Caking Portion. Per Cent.	Centre of Box. Per Cent.	Bottom of Box Per Cent.
Sulphur	59.49	61.28	61.90
Tar, etc	6.77	1.81	1.22
Ammonium sulphocyanide (NH_4SCn)	4.63	1.72	0.13
Prussian blue ($Fe_4[Fe(Cn)_6]_3$)	4.72	5.23	6.21
Moisture in oxide as taken from box	5.38	1.92	1.42

This box had been on continuously for 11 months. The filtering action of the oxide is shown by the diminution of the tar content as we go down in the box. (Gas entered at top.)

The decrease in ammonium sulphocyanide may be due to less being formed, or to the solvent action of the increasing water of formation in falling through the oxide. The caked portion, 6" deep, was extremely hard, requiring picks to break through it; the remainder was quite loose and powdery. We are now taking steps to more effectively remove the tar-fog.

Tests for oxygen, as well as for H_2S should be made at the inlet and outlet of purifiers; and it is an advantage to make quantitative tests about once a week to ascertain what each box is doing.

The theoretical quantity of air to admit is two-and-a-half times the H_2S content by volume. If admitted on the vacuum side of the exhauster, the scrubbers take up some of the oxygen, and it is best to be guided by the oxygen content at the inlet of the purifiers. About 0.6 time the H_2S works well in practice, leaving only a trace in the outlet gas.

At many works, elaborate arrangements of blowers, stepped cones, and air-pipes are used for putting into the gas a fixed proportion of air for revivification, though it is probable that more than enough oxygen for this purpose is being "pulled" into the gas during the "draws" and through leaky lids.

If the oxide gets acid in character, the H_2S converts it into iron pyrites, which does not revivify into activity. To prevent this, allowing a trace of ammonia to go forward with the scrubbed gas is sometimes advocated, though in ordinary scrubbed gas there are generally from two to three grains of ammonia per 100 cubic feet of gas, sufficient with most oxides to prevent acidity. With gas thus slightly alkaline, ferric sulphide is produced, which revivifies readily. Further, any ferric sulphide oxidized to sulphate will be decomposed into ammonium sulphate and ferric hydroxide, which will be in a very active state for taking up sulphuretted hydrogen.

Upward or Downward Flow?

It is a decided advantage to work with inlets at the top and outlets at the bottom. When the gas enters at the bottom, the grids occupy one-half the area presenting itself to the gas, which means that the action on the other half area of oxide is doubled. Further, should caking take place, the water of formation from the material collects on this cake and assists in obstructing the flow of gas. When the gas enters at the top, if there is caking it is over the whole area of the box, and the time elapsing before excessive pressure is correspondingly longer. It is then a simple matter to take off the covers and break up the cake without disturbing the rest of the oxide.

Again, with the downward flow the water runs away freely

through the loose material underneath. It is the practice at some works to periodically reverse inlets to outlets and *vice versa*; one object being to sulphide the oxide more uniformly. Our connections are not arranged for this; and the analyses of the sulphur content of the oxide at different depths in the purifier do not show that any advantage in this direction would be gained.

Hurdle grids are in advance of the ordinary kind. From 28 to 30% more oxide is got into a box, and it is held more loosely and of fairly even density throughout, so that there is more even sulphiding and less back-pressure. If the oxide be well packed at the walls of the box, there is no short-circuiting. In filling up the box, sufficient room must be left between the oxide and the cover to allow for increase of bulk. In emptying a box with hurdles in use, care must be exercised. If the material has not caked the hurdles come away readily, and the oxide is easily shovelled out; but if caking has taken place, a pick is necessary to break the cake, and there is a risk of damaging the grids.

The time needed to empty and fill a box is about the same as with ordinary grids. It is a good plan to have the boxes elevated, with a mixing floor above. The oxide can then be stored ready mixed under cover, and charged into the boxes by means of canvas shoots, with the minimum of labor. When spent, it is also readily discharged. The rubber lute type of cover is now generally recognized as the most advantageous. The covers may be made in sections, and the lifting gear made correspondingly lighter. There is also no danger of lutes blowing, and no corrosive action as between wind and water in the water-lute type. In working the rotation system, the interval between changing valves is sometimes so long that, when attempting to change, it is found that the valves have become very stiff. To prevent this, the spindles should be kept clean and well lubricated, and the valves run up periodically.

The sulphur content of the gas supplied to the town averages 7.6 grains per 100 cubic feet. This low figure led to the thought that some reduction in sulphur compounds other than H_2S took place in the purifiers, possibly due to the absorption of CS_2 by the large amount of free sulphur in the oxide. Gas was led from the inlet of the purifiers through two small purifiers containing entirely new oxide, and thus freed from H_2S. The gas was then tested for sulphur compounds. The result of the test showed 9.06 grains of sulphur per 100 cubic feet at the inlet of the purifiers proper, and 5.7 grains at the outlet. It is to be noted that this is the result of one test only, and would need confirming.

While on the subject of CS_2, the following reversible reaction may be noted as possibly having some bearing on the fact that gas may be quite clean at the works and yet show faint traces of H_2S in part of the district.

$$CS_2 + 2H_2O \rightleftharpoons CO_2 + 2H_2S$$

The action takes place rapidly at 212° F. and moderately at temperatures above 77° F. This also may explain how in a works such as ours, where even a trace of H_2S in the gas leaving the works is practically unknown, yet on analyzing the deposits in the service pipes free S was found.

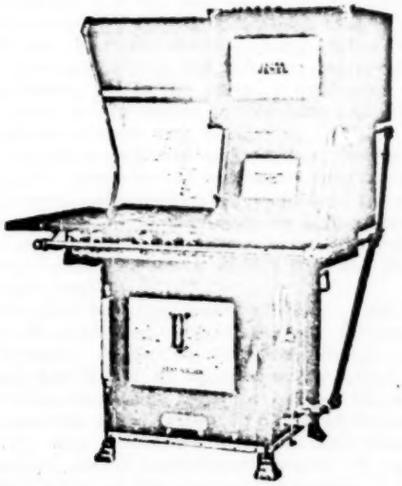
Since adopting the "forward rotation" system we have had no outside revivification; the oxide once put in the boxes not being removed until ready for sale. This is of special benefit during these times of labor scarcity, and financially it has meant that for the last two-and-a-half years our purification has been a source of profit to the department.

New Methods and Appliances.

COMBINATION FIRELESS COOKER AND RANGE. Messrs. Geo. M. Clark & Company report a notable interest in their new "Heat Holder" line, which includes the features of the "fireless cooker" incorporated in a gas range.

In describing this appliance they say: In the ordinary gas stove the heat passes slowly through the oven and out the flue. The construction is such that an even heat is obtained, but no attempt is made to provide heat storage or prevent losses up the flue, and but little to reduce radiation. As a result, very soon after the gas flame is out, the oven falls below cooking temperature.

In such a stove the methods of a "fireless cooker" are not possible—long cooking with little evaporation which cooks thoroughly, saves the food juices and flavors, and makes the tougher and less expensive meats tender.



The "Heat Holder" makes both kinds of cooking possible—quick, direct-heat cooking, and fireless. Its construction provides heat-storing plates, thorough insulation of the oven walls and door, and dampers to stop losses up the flue when gas is turned off. A mercury thermometer shows the oven temperature.

Better than the ordinary fireless cooker, there is no moving of the food or heating plates, from the time food is put in oven until it is ready to take out for serving.

The operation of the oven is simplicity itself. The door is opened and the gas lighted. Food is placed in the oven and the door closed. When thermometer shows desired temperature the gas is turned off and dampers closed, sealing up the heated oven, and the food is left to go on cooking.

The lever that turns the gas on opens the dampers. When the gas is turned off the dampers are closed all automatically.

When the gas is burning, the plates, the walls of the oven and the food take up heat. When the gas is turned off the closed dampers and the heavy insulation keep the heat, in so the cooking goes on for hours.

Depending on the amount of gas burned and whether or not food is already in the oven, it will take from 17 to 25 minutes to bring the temperature of the oven up to 375 degrees a (normal baking heat). When the proper temperature is reached the control lever is moved to position marked "Gas Off—Dampers Closed" and the oven is a Fireless Cooker.

A minute before opening door put lever to "Gas Off—Dampers Partly Open." This will let odors of cooking and accumulated steam go up the flue instead of into the kitchen.

NEW SYPHON GAUGES. — The latest syphon gauges designed by the American Meter Company are a decided improvement on anything previously made. The bent glass tube is supported in a metal bottom piece attached to the pipe upright; and is held in place against rubber gaskets in the top casting by a tie rod. There are no plaster paris joints, and it is but a matter of a few minutes to replace a broken tube. This pattern gauge can be had in all sizes.

Items of Interest from Various Localities.

THE First National Bank of Rome, Ga., prints a notice extolling the "public service work" in Rome, and says this of the gas company: "So with the Rome Municipal Gas Company, under the able and conscientious management of Mr. Ferrier. He has had many obstacles, many hardships, in the way of street improvements and the bridge building here, but he has kept right on, meeting the difficulties like a Roman soldier."

NEW examinations will be held for the $2,800 position of gas expert under the Ohio Public Utilities Commission, because only two applicants passed the first examinations before the State Civil Service Commission. Fred C. Corey, of Fostoria, and Walter H. Albaugh of Columbus, were successful, but it is necessary for three to pass and be certified.

SINCE the freight troubles began in New England the subject of coke supply and prices has been particularly interesting to manufacturers in that section. At the monthly meeting of the New England Foundrymen's Association, held at the Exchange Club, Boston, the principal speaker was W. J. Lavelle, New England Coal and Coke Company, who made an able presentation of the merits and field of application of "By-Product Coke." After briefly recounting the history of coke making in the United States, the various ovens and coking processes and the handling of coke, he discussed the comparable values of by-product and beehive oven cokes and made some observations on cupola practice. In closing, he described the plant of the New England Coal and Coke Company, and gave a resumé of its experiences and experiments in the manufacture of by-product coke and sketched briefly the growth of consumption of coke in New England.

THE continued growth of the gas business in Northfield, Minn., has made it necessary for the Northern States Power Company to plan enlarged holder capacity in Faribault and the installation of a larger compressor at Northfield.

"THE GAS WORLD," London, notifies its readers that owing to the scarcity of print paper, the price for which has gone up about 200%, the Government has decided to restrict the use of paper to 33⅓% of the supply in the year 1914. This, it says, means that "The Gas World," in common with other technical and non-technical journals, will be obliged to reduce the number of its pages.

THE officials of the Denver, Col., Gas and Electric Light Company, operated by Henry L. Doherty & Company, recently were the guests at a banquet of C. T. Brown, vice-president of the latter company. Mr. Brown in speaking of salesmen who are always wanting to cut prices in order to meet competition, said, "a salesman who cannot sell except by cutting prices, is a liability to the company employing him."

A BILL introduced in the Massachusetts Assembly to compel testing, resealing and setting back of all gas meters, once in every five years, met with solid opposition from the gas plants at the hearing. John T. Fennell of the Electricians' Union was the only proponent. William A. Wood, for the Boston Consolidated Gas Company, and John J. Kirkpatrick, manager of the Holyoke Gas and Electric Lighting Department, testified that the bill would work unnecessary hardship of no value either to the company or the consumer. E. W. Burdett, stated that it was the practice of gas companies to retest their meters every five years. C. E. Paige, manager of the Malden and Melrose Light Company, testifying as an expert, outlined the policy of his company.

CONTRACTS have been awarded for four buildings to be built at Sassafras Point, R. I., for the Providence Gas Company, from plans by the Bartlett Hayward Company. There will be a generator house, 2½ stories high, 57 x 127 feet; a purifier house, 2½ stories high, 61 x 112 feet, an exhauster and pump house, one story high, 41 x 66 feet, and a tar extractor and washer house, 1½ stories high, 34 x 38 feet. All of the buildings will be of brick and stone, with tile roof, granite sills and terra cotta trim.

THE annual convention of the Southwestern Gas and Electrical Association will be held in Galveston, Tex., beginning May 17.

THE Western Gas Construction Company is shipping an average of three carloads of material a week to Canal Dover, O., for the big coke and gas plant being erected there. About 450 tons of machinery and iron plates have already been sent, and nearly 750 tons are yet to go.

THE New Bedford (Mass.) Gas and Edison Light Company has bought the property of the F. T. Akin Company situated east of Water street and south of Coffin street, and intends to use the property for the extension of its plant.

THE Indiana Fuel and Light Company, at the present time supplying gas to Auburn, Garrett and Kendallville, has secured a franchise at Avilla. The securing of this franchise is a part of the plan of the company to furnish gas to the four places and to farmers between Auburn and Kendallville along the new main to be laid from the Auburn Junction plant to Kendallville.

THE Ramsdell Construction Company has been given the contract to build an addition to the gas plant of the Illinois Northern Utilities Company, at Sterling.

"GAS—an increased output for 1916" is the slogan adopted by the Fitchburg (Mass.) Gas and Electric Company, C. R. Hayes, manager. An energetic solicitor is devoting the greater part of his time to the sale of gas for industrial uses, and to date the company has sold a number of furnaces and other appliances. The company's gas heater campaign, begun last autumn, has been very successful. More than 600 yellow flames, copper reflector heaters have been sold, about 300 being in constant daily use in homes where there is no cellar heating plant. The profit on the heaters has been sufficient to cover the cost of selling, apart from the newspaper advertising involved.

IF the State Railroad Commission will permit the Central California Gas Company of Visalia, Tulare, Exeter, Lindsay, Strathmore and Porterville to issue $18,000 of bonds and 500 shares of preferred stock, as prayed for, $30,000 will be expended at once in improvements of the Visalia plant. The company has been anxious to do this for some time, but has not been able to get the money by reason of troubles with the railroad commission.

THE Jackson County Light, Heat and Power Company has submitted a new schedule of rates for Independence, Mo., to the State Commission. At present the flat rate is $1.15 per thousand net, and the proposed rates provide a $1.25 rate up to two thousand feet a month and all over that to be supplied at 75 cents. Robert S. Miller, manager of the company says it has physical property worth $236,000, pays no dividends and last year earned only 4% on the investment.

THE second artificial gas plant in Wyoming is to be built at Sheridan by the Sheridan Gas Company, just incorporated with a capital stock of $100,000. Simultaneously with the filing of the incorporation papers the company applied to the Public Service Commission for a permit to supply Sheridan with gas. The directors of the corporation are John T. Bacon, Charles H. Pierce and Don R. Means of Denver.

INCREASING population in Richmond, Cal., and consequent extensions of the Pacific Gas and Electric Company's mains throughout the city has made a greater supply of gas necessary. The company is preparing to spend $50,000 on improvements, one of the main items being a larger main from its works in Berkeley.

BIDDING for a new contract for gas for the street lamps and municipal buildings in Baltimore, the Consolidated Gas, Electric Light and Power Company offered the city a reduction of from 20 to 25 cents per lamp a year. For gas consumed in municipal buildings the company quotes the existing rate 70 cents per 1,000. The new contract will be based on 11,687 street lamps, and the city expects to use a total of between 125,000,000 and 130,000,000 cubic feet of gas next year.

"SERVICE TALKS," a publication issued by the Massachusetts Lighting Companies, this month has a fine picture of Supt. Robert E. Freel of the Clinton Gas Light Co., on the cover.

SAFETY first was the keynote of the first day of the meeting of about 100 managers, accountants and engineers of subsidiary companies of the American Gas Company held in the company's headquarters, Seventh and Locust streets, Philadelphia. A banquet was served that night in the Bellevue-Stratford, after which the visitors were guests of the local men at the theatre. Men attended from Maine, Massachusetts, Vermont, New York, Pennsylvania, Virginia, Illinois, Indiana, Iowa and Wisconsin. S. P. Curtis, general manager, presided at the session, and the speakers included President M. W. Stroud. H. W. Forster, of the Independent Inspection Bureau, showed lantern slides in his talk on "Fire Hazards." The afternoon session was addressed by James D. Douglass, president of the Philadelphia Claim Men's Association, who illustrated a talk on "Safety First," with motion picture reels; and Chairman Harry A. Mackey, of the Workmen's Compensation Board, who told of the Compensation act's provisions.

AT the regular bi-monthly meeting of the Woonsocket (R. I.) Gas and Electric Employees' Club, Mr. Bettinger of the Stone & Webster Engineering Corporation, gave a talk on "Coal Gas Manufacture."

AT the last meeting of the Pittsfield (Mass.) Gas Employees Association it was voted to bond the treasurer for $1,000. At the next meeting the members are to discuss "Things that trouble us." The "eats" committee consists of Patrick J. Lynch, chairman; Francis J. Connor, Noel Daniels, Frank Sherman, John Walsh.

THE Bridgeton Gas Light Company is one of the important concerns in Bridgeton, N. J., at present having 3,200 gas users, more than are credited with the use of city water. There are hundreds of all-gas-kitchens in Bridgeton, and in scarcely any new house is there a coal burning range. Gas heating apparatus is being installed more and more.

THE Henry Bower Chemical Manufacturing Co., which advertises for spent oxide, has been identified with the gas industry for 50 years. Mr. Henry Bower, the founder of the business, built and operated the first ammonia scrubbers used by the Philadelphia Gas Works, and one of these is still in operation. The company has for many years been engaged in the manufacture of Ferrocyanide of Potash and Soda, recovered from the by-products of gas works.

MR. H. H. THWING, works superintendent of the Citizens Lighting Company, LaSalle, Ill., died at his home in that city on March 15th. Mr. Twing's gas experience covered 20 years of successful work; first with the Laclede Gas Light Company, St. Louis, Mo., then as superintendent at Du Quoin, Ill., for the Du Quoin Light, Heat and Power Company, and, last, in LaSalle. Interment was at Toledo, Ohio. He was a brother of O. O. Thwing, of the Western Gas Construction Company.

M. M. MILTON, of the Roanoke, (Va.) Gas Light Company, delivered an address before the Roanoke Engineering Club last week, on "Illuminating Gas, Its Manufacture and By-Products." Mr. Milton is an effective speaker and has a thorough knowledge of his subject. The attendance while not large, was appreciative, and thoroughly enjoyed the address. Mr. Milton has been asked to address the club again.

THE Franklin Institute has awarded its Edward Longstreth Medal of Merit to Benjamin G. Waggner, of Philadelphia, Pa., for improvements in prepayment gas meter valve-closing mechanisms.

A BILL, endorsed by the First District Public Service Commission, has been introduced in the New York Legislature, extending the 80-cent gas rate to parts of Brooklyn and Queens not included in the law passed in 1906. They are the Thirtieth Ward or Bay Ridge, where the Kings County Lighting Company charges 95 cents, and the Thirty-first Ward, or Coney Island, where the price is $1, and in Queens, the Second Ward, where the Newtown Gas Company charges $1.

Utilities Commission News.

POINTS DECIDED IN COLORADO SPRINGS RATE CASE.—The application of the Colorado Springs, Light, Heat and Power Company for a rehearing of its rate case, decided by the Public Utilities Commission of Colorado in December last, has been denied, but the commission has somewhat modified its order.

The commission held that under the law its duty in fixing rates for a utility is to establish just and reasonable rates applicable to all consumers and purchasers under like conditions, even if it abrogates contracts between the utility and consumers. It is a presumption that contracts between utilities and their consumers are within the scope of regulation, unless the contrary has been expressly set forth, and the State is empowered to regulate and abrogate contracts which purport to cover rate regulation.

The commission found no authority or precedent for combining gas, electric and water properties as one, when they were in no way physically connected and where to have combined them would compel the patrons of one class of service to help maintain the others. The same was held true for the steam heating properties, although here it was found difficult to always separate this property from the electric property.

The commission further held that a public utility is not subject to the general law of competition, its position being different from that of a private concern. Its service must be continuous, uninterrupted and adequate and should be supplied at the lowest reasonable cost; and in fixing reasonable rates for utilities the commission should, after arriving at the present fair value of the property, permit the utility to earn a fair rate of return upon that value, and set aside a proper annual depreciation reserve if the rates thus made are not in excess of the value of the service.

One of the great underlying dangers of state regulation, it was stated, is the attitude of public-utility corporations in claiming large intangible values in order to present a large paper property valuation.

The Commission prescribed $52,000 to be set aside as an annual depreciation reserve on the hydro and electric properties, the value of which was fixed at $1,481,762; and an annual sum of $20,000 as depreciation reserve on its gas property, the value of which was fixed at $710,917. One of the tests used by the commission in arriving at the fair value was "reproduction cost" less depreciation, but it was unable to settle on any one test as the sole basis of arriving at a value.

The Commission found the book values of the three companies forming the present company was $4,666,968.25 on June 30, 1910, and $4,887,183.77 on June 30, 1915. Of this, approximately $1,000,000 was intangible values or watered stock, and as the property of the old companies had been acquired by bonds and stocks and the retirement of indebtedness, the discounting of which, and the value of the stocks not being shown, but carried at par value on the book accounts, the book value might be reduced. It was found impossible to determine what amount of the remaining book value of the property purchased was properly chargeable to construction cost rather than to operating expenses, and it could not ascertain whether other expenditures included in the tangible book value were prudently and wisely made. Therefore, it was held, any determination of the book value of the company would be no more than a guess, and consequently of little use.

In the valuation, an estimated deduction from book value was made for property purchased from previous companies and abandoned, or not in use or useful in the operations of the present company.

The Commission was of the opinion that no allowance should be set aside to protect the company against extraordinary accidents of the future, and said that in the regulation of public utilities it must act in a dual capacity and not only protect the public in the charges it is required to pay, and the adequacy of the service, but at the same time protect the utilities and their stockholders from losses due to poor management. The Commission takes the position of condemning wasteful operation, and encouraging efficient management; and believes it would not be wise to prohibit an operating company from paying a holding company 2% on gross sales, to cover general supervision expense.

Financial Notes.

DIRECTORS of the CITIES SERVICE COMPANY have decided to resume dividends on the common stock at the rate of 6%, paying them in convertible debenture bonds of the same issue used for the payment of accumulated preferred dividends some weeks ago. This will call for the distribution on July 1 of warrants for convertible bonds to the amount of 3% of the common stock outstanding. After that date the company will pay cash dividends of ½% monthly, the first to be paid August 1. The rapid growth in earnings being made by the company is shown in the 12 months ended February 29, 1916, when gross increased $1,060,086 or 27%; and the balance available for dividends on the common stock increased $836,574 or 48% over the corresponding 12 months in 1915. Gross earnings for February alone increased $285,242 or 73%, and balance for dividends on the common stock increased $241,025 or 118% over February, 1915. For the 12 months ended Feb. 29, 1916, after providing for all expenses and the interest on the 7% notes and the 5% Debentures, the balance available for preferred dividends was 2.63 times the requirements as against 2.07 times preferred dividend requirements in the preceding 12 months. After providing for the preferred dividends, the balance available for the common stock was equivalent to 17.54% on the outstanding issue as compared with 11.32% for the preceding year. Reports from the subsidiary properties indicate that these large gains in earnings, with a consequent enhanced income accruing to Cities Service Company, will be continued throughout the current year.

FOR the year 1915 the PROVIDENCE GAS COMPANY reports earnings of $1,494,989.61 and operating cost of $877,086.48 or a gross operating profit of $617,902.13, which is applicable as follows: Interest, $46,738.06; depreciation, $120,000; dividends; $392,000, and a surplus of $59,165.07. The report speaks of the fact that the company has a contract for gas oil at a price which cannot be duplicated at the present time. Owing to the fact that the company is now distributing its product outside the limits of the city of Providence, the report shows it was impossible to maintain an even pressure at all times throughout the 24 hours in the day and on that account it became necessary to make a large and expensive reinforc[illegible] the distributing system. In this connection a 3,000,000 [illegible] holder was built at Hartford and Pettey's avenues and a lo[illegible]umping line laid from the Sassafras Point plant. There have been 7½ miles of pipes of other sizes laid. The commercial end of the business has also been gratifying, the sale of appliances being 33% greater than in 1914.

EARNINGS of the STANDARD GAS AND ELECTRIC COMPANY in the year ended December 31, 1915, after payment of fixed charges, were 6.3% on the $11,784,950 preferred stock, upon which dividends of 4% were paid, leaving a surplus for the year of $270,979.

AN increase of 8.2% is shown in the net earning of the WESTERN STATES GAS AND ELECTIC COMPANY for the year ended February 29, 1916, as compared with corresponding period previous year, while the increase in gross for the 12 months was 5.7%. Comparative figures are reported as follows:

Year ended February 29	1916	1915	Increase	Percent. Increase
Gross Earnings	$1,198,253	$1,134,114	$64,139	5.7%
Net Earnings	581,589	537,095	44,493	8.2%

THE CAMBRIDGE GAS LIGHT COMPANY is offering 1,200 shares of new stock to shareholders for subscription at $200 a share in the ratio of one new share for 13 present shares. Subscription rights expire April 14, and the stock must be paid for on or before April 28. Proceeds will be used for construction purposes. Cambridge gas light stock is quoted at 250, and the rights at 2⅞.

THE GENERAL GAS AND ELECTRIC COMPANY and subsidiaries report for the seven months ended January 31 gross operating revenues of $1,526,773. After allowing for operating expenses and taxes and including miscellaneous income there was a gross income of $554,494. Net income was $262,497. The subsidiary companies showed combined operating revenues in February of $246,957, an increase of 23.7% as compared with the corresponding month of 1915.

AUTHORITY to issue $125,000 5% gold bonds is given the GEORGETOWN GAS LIGHT COMPANY by the District of Columbia Public Utilities Commission. The issue is authorized with the provision that $100,000 of the proceeds be used for the payment of notes heretofore made and for moneys borrowed and used for the acquisition of property, and the construction, completion, and extension of the company's plants. The remaining $25,000 is to be used for the construction of a supply main to serve the territory in the vicinity of Woodley Park. It is provided also that the company shall sell the bonds at the highest obtainable price under such details of sale as may be approved by the commission.

THE SAN DIEGO CONSOLIDATED GAS & ELECTRIC COMPANY has filed with the California railroad commission an application for authority to increase its capital stock from $3,500,000 to $6,000,000, and to issue and sell $500,000 worth of preferred stock. The proceeds are to refund $356,000 par value of 6% debenture bonds, and reimburse the company for expenditures from income for additional and betterments to its service totaling $115,564.06. If granted permission the company will divide its stock into 60,000 shares, 20,000 preferred and 40,000 common.

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